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Obesity and Undiagnosed Diabetes in the U.S.

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OBJECTIVE — To study whether obese individuals, who are at higher risk for diabetes and disparities in care than nonobese individuals, are more likely to have undiagnosed diabetes.

RESEARCH DESIGN AND METHODS — We performed an analysis of 5,514 adult participants in the 1999–2004 National Health and Nutrition Examination Survey. Particpants were interviewed about sociodemographic and medical data, including whether they had been diagnosed with diabetes, and were examined for height, weight, and fasting plasma glucose level ≥126 mg/dl or by previous physician diagnosis. After categorizing participants into normal weight, overweight, and obese according to BMI, the prevalance and diagnosis of diabetes across BMI categories was compared using χ^2.

RESULTS — Of the 9.8% (weighted sample) of participants who had diabetes, based on fasting glucose levels and self-reported diagnosis, 28.1% were undiagnosed, translating to an estimated 5.2 million people in the U.S. population. The proportion undiagnosed was not significantly different among normal-weight (22.2%), overweight (32.5%), or obese adults (27.4%). Nevertheless, obese adults comprise more than half of the undiagnosed diabetes cases (2.7 million). Relative to normal-weight adults, the adjusted odds ratio (OR) for having undiagnosed diabetes was 1.50 (0.73–3.08) in overweight and 1.37 (0.72–2.63) in obese adults.

CONCLUSIONS — Despite a higher underlying risk of diabetes and widespread clinical recognition of this higher risk, obesity does not increase the likelihood that an individual's diabetes will be diagnosed.

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The rise in obesity has led to a comparable rise in type 2 diabetes, a major cause of death, morbidity, and disability (1,2). National guidelines differ, however, on whether screening asymptomatic individuals is recommended (3,4). The American Diabetes Association advocates screening adults aged 45 years and older, whereas the U.S. Preventive Services Task Force found insufficient evidence to recommend mass screening (3,4). Lack of uniform screening guidelines and potential delays in diagnosing diabetes is of particular concern in obese populations, not only because of their high risk for developing diabetes but also because evidence suggests that obese individuals experience healthcare disparities that include delays in receiving preventive care (5). We examined whether BMI category affects the likelihood of having undiagnosed diabetes among U.S. adults.

RESEARCH DESIGN AND METHODS

We used data from the 1999–2004 National Health and Nutrition Examination Survey (6). Participants were interviewed about sociodemographic and medical data, including whether a doctor had diagnosed them with diabetes, age at diagnosis, and whether they were taking medications for diabetes. Physical and laboratory examination included measured height and weight and, in half the sample, fasting blood plasma glucose; our study included all adults ≥20 years of age with recorded fasting plasma glucose.

We calculated BMI from measured height and weight and classified participants as normal weight (BMI 18.5–24.9 kg/m^2), overweight (BMI 25.0–29.9 kg/m^2), and obese (BMI ≥30.0 kg/m^2). We excluded underweight (BMI <18.5 kg/m^2) participants and women who were pregnant.

Participants were defined as having evidence of diabetes if a doctor told them they had diabetes or if their fasting glucose was ≥126 mg/dl based on American Diabetes Association criteria (7). We classified participants with diabetes as diagnosed if they were aware of their condition.

We compared the prevalence and diagnosis of diabetes across BMI categories using χ^2 tests. We developed multivariable models to examine the association between BMI and undiagnosed diabetes adjusting for relevant confounders (Table 1). The National Health and Nutrition Examination Survey does not distinguish type 2 (adult onset) diabetes from type 1 diabetes; therefore, we repeated our primary analyses excluding participants diagnosed before age 30 years who were on insulin. We weighted analyses to reflect U.S. population estimates and used SUDAAN to derive appropriate SEs.

RESULTS

Of 5,514 adults, 658 (9.8%) demonstrated evidence of diabetes, representing an estimated 18.6 million U.S. adults; of these, 28.1% (estimated 5.2 million) were undiagnosed.

Obese adults had a higher prevalence of diabetes than overweight or normal-weight adults ($P \leq 0.001$; Table 1.) The proportion of those undiagnosed was comparable between obese (27.4%, 99 of 327), overweight (32.5%, 68 of 225), and normal-weight adults (22.2%, 32 of 106; $P = 0.32$). In the U.S., obese adults comprise an estimated 2.7 million of the 5.2 million adults with undiagnosed diabetes; overweight and normal-weight adults comprise 1.8 and 0.7 million, respectively.

Table 1 presents adjusted ORs for having undiagnosed diabetes by BMI category. Among those with diagnosed

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Table 1—*BMI, diabetes prevalence, and the likelihood of having undiagnosed diabetes in U.S. adults**

BMI (kg/m^2)	Overall sample (N = 5,514)	Sample with diabetes†	Undiagnosed in sample with diabetes (N = 658)	OR (95% CI) of having undiagnosed diabetes among those with diabetes	
				Age-, sex-, race-adjusted OR	Fully adjusted OR‡
18.5–24.9	34.2	4.9	22.2	1.00	1.00
25.0–29.9	35.0	8.5	32.5	1.60 (0.78–3.29)	1.50 (0.73–3.08)
≥30.0	30.8	16.8	27.4	1.29 (0.65–2.57)	1.37 (0.72–2.63)

Data are % unless otherwise indicated. *All percentages are weighted to reflect U.S. population estimates. †Estimates represent the weighted prevalence of diabetes in the population by BMI category; 658 of 5,514 adults had evidence of diabetes (both diagnosed and undiagnosed). ‡Results among sample of those with evidence of diabetes (both diagnosed and undiagnosed) and adjusted for age, sex, race/ethnicity, education, health insurance, usual source of healthcare, and number of healthcare visits in previous year. When adults who used insulin and who were younger than age 30 years at diagnosis were excluded, the OR (95% CI) was 1.20 (0.55–2.60) for overweight and 1.21 (0.58–2.50) for obese adults.

diabetes, adults with higher BMI were not any less likely to have undiagnosed diabetes.

CONCLUSIONS — Despite widespread recognition that obesity is a strong risk factor for diabetes, we found that obese adults were no more likely to have their diabetes diagnosed than nonobese adults. Obese adults account for 2.7 million cases, or more than half of the 5.2 million cases, of undiagnosed diabetes each year in the U.S.

Our findings complement those of Gregg et al. (8) who examined trends in diagnosed and undiagnosed diabetes by weight category. While that study did not specifically compare the likelihood of having undiagnosed diabetes across different BMI groups, Gregg et al. did find that adults with moderate to severe obesity had the largest relative decline in the ratio of undiagnosed to diagnosed diabetes.

The finding that adults with higher BMI are no more likely than those with lower BMI to have their diabetes diagnosed is somewhat unexpected given the widespread recognition of obesity's predisposition toward diabetes. One reason may be that a disproportionate number of normal-weight adults identified with diabetes have type 1 diabetes, which often produces symptoms earlier in the disease course. Delays in diagnosis in overweight and obese adults who are at higher risk of type 2 diabetes may reflect delays in experiencing, recognizing, and presenting symptoms of diabetes in a timely manner. Competing health concerns, social stigma, and health system bias, however, may also contribute to this phenomenon (9,10).

Furthermore, because some guidelines do not recommend systematic screening, clinicians may place lower priority on screening for diabetes in favor of more established preventive measures. Given the higher risk of diabetes, lack of systematic screening has greater implications for obese adults. Even though obese adults comprise only one third of the general population, they comprise more than 50% of U.S. adults with undiagnosed diabetes. Studies suggest that routine screening for diabetes is highly cost-effective (11). However, whether pharmacologic treatment of early type 2 diabetes yields benefits that outweigh the potential costs of screening and early diagnosis is unclear. Nevertheless, timely diagnosis may lead to indirect benefits, especially among those with overweight and obesity, by motivating efforts to control weight and enact lifestyle changes such as improving diet and exercise, which have been shown to reduce the risk of developing diabetes (12). Future studies are needed to examine the public health impact of screening strategies that incorporate a nuanced consideration for overweight and obesity.

Our study has limitations. Formal diagnosis was based on self-report. Standardized BMI cut points tend to underestimate risks of higher weight in Asians (13). In addition, our sample size, particularly among normal-weight adults with evidence of diabetes, was relatively modest; it is possible that we were underpowered to detect meaningful differences in the likelihood of having undiagnosed diabetes across different BMI groups.

In summary, obese adults are no more likely to have their diabetes diagnosed than normal-weight or overweight adults. Because of their higher disease risk, obese adults account for more than one-half of those with undiagnosed diabetes in the U.S. Clinicians and policy-makers may want to consider the underlying risk of diabetes associated with body weight in making decisions concerning whom should be screened for diabetes.

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